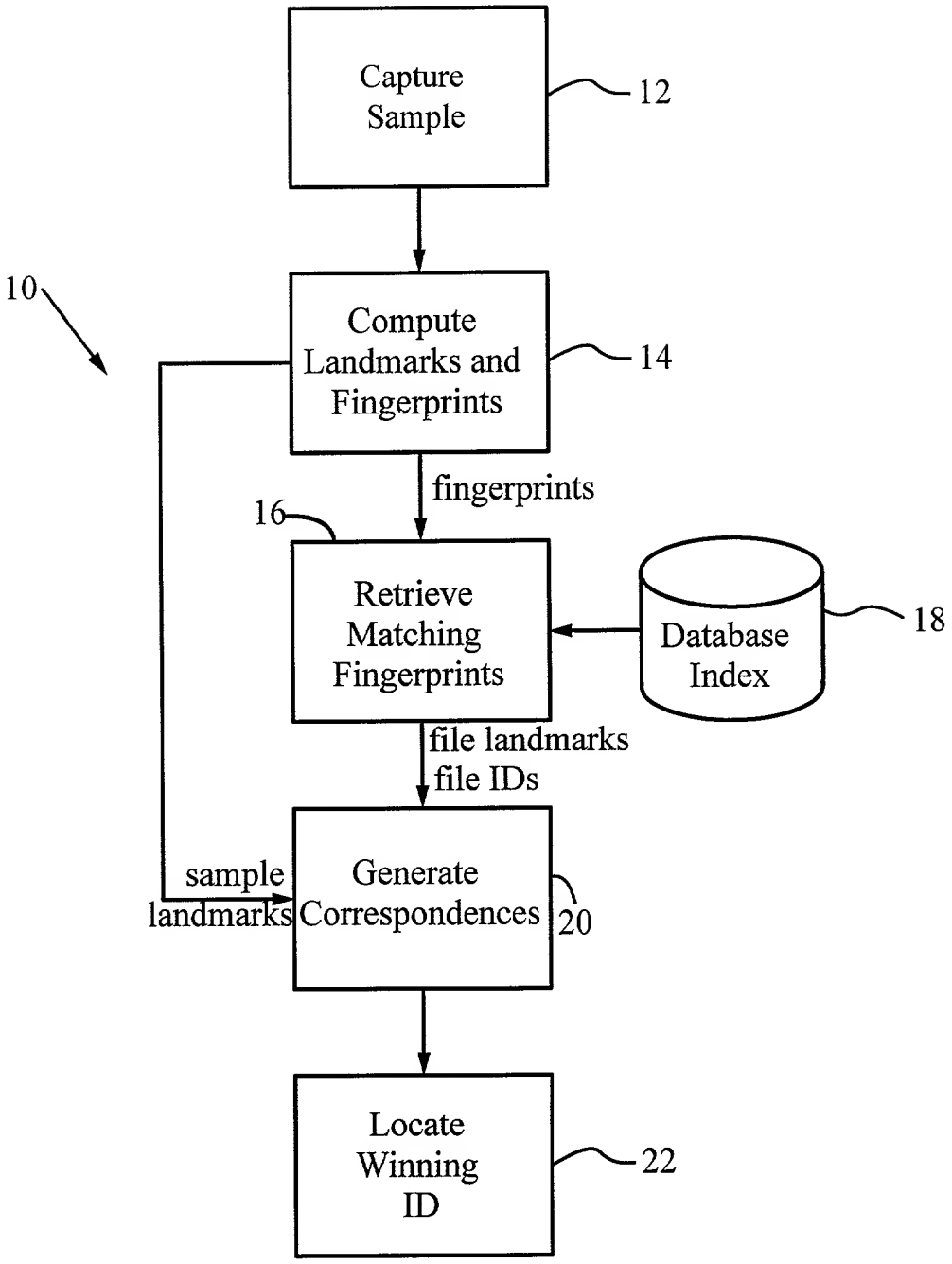

FIG. 1

US 8,315,457 B2

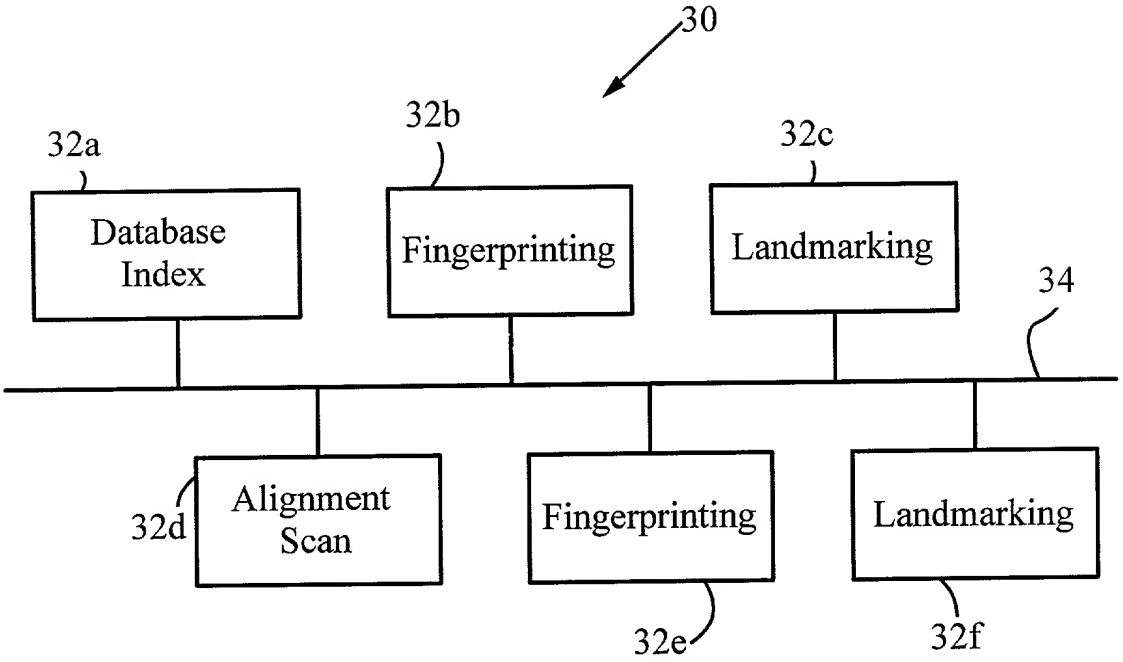
30
32a
Database Index
32b
Fingerprinting
32c
Landmarking
34
32d
Alignment Scan
Fingerprinting
32e
Landmarking
32f

FIG. 2

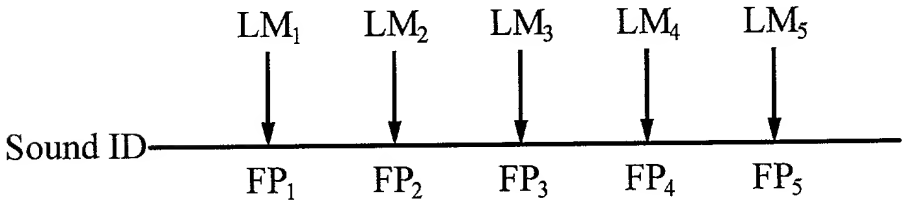
LM1
LM2
LM3
LM4
LM5
Sound ID
FP1
FP2
FP3
FP4
FP5

FIG. 4

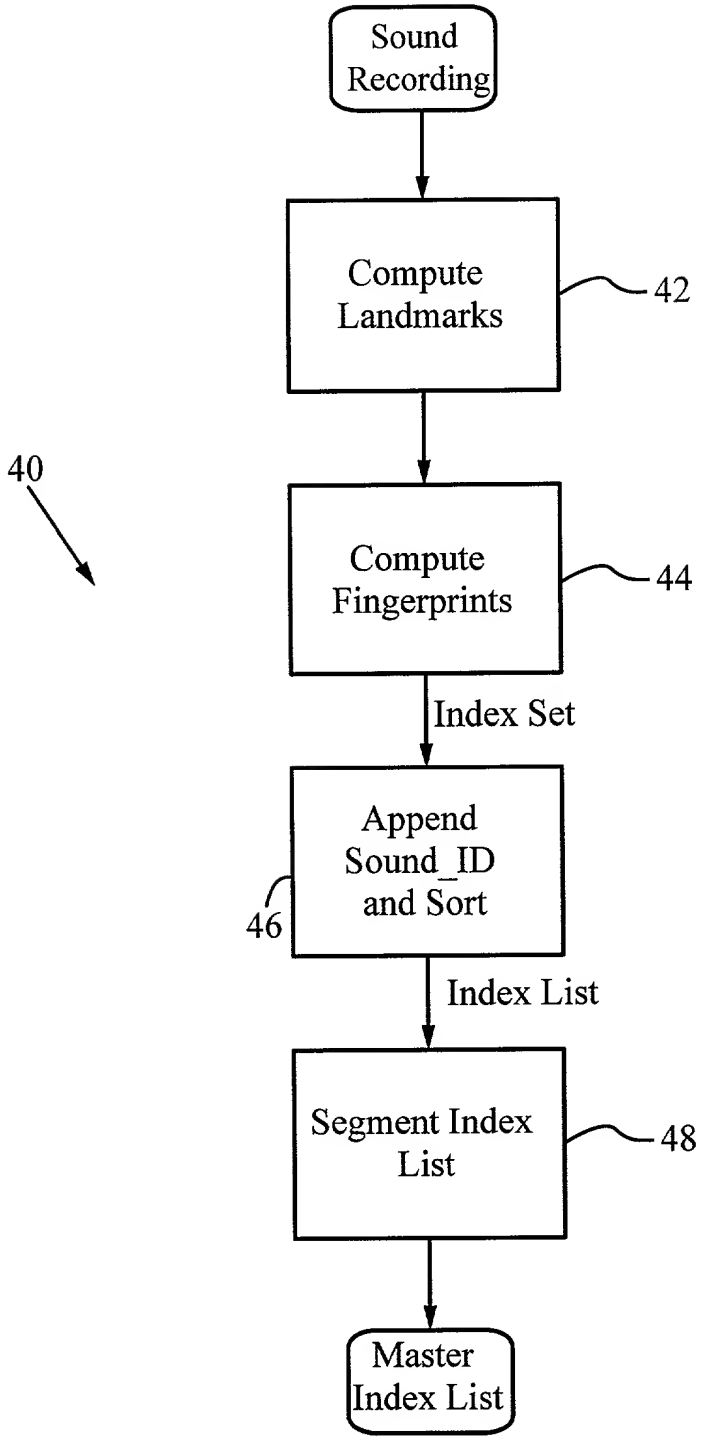

FIG. 3

09894795 - 042501

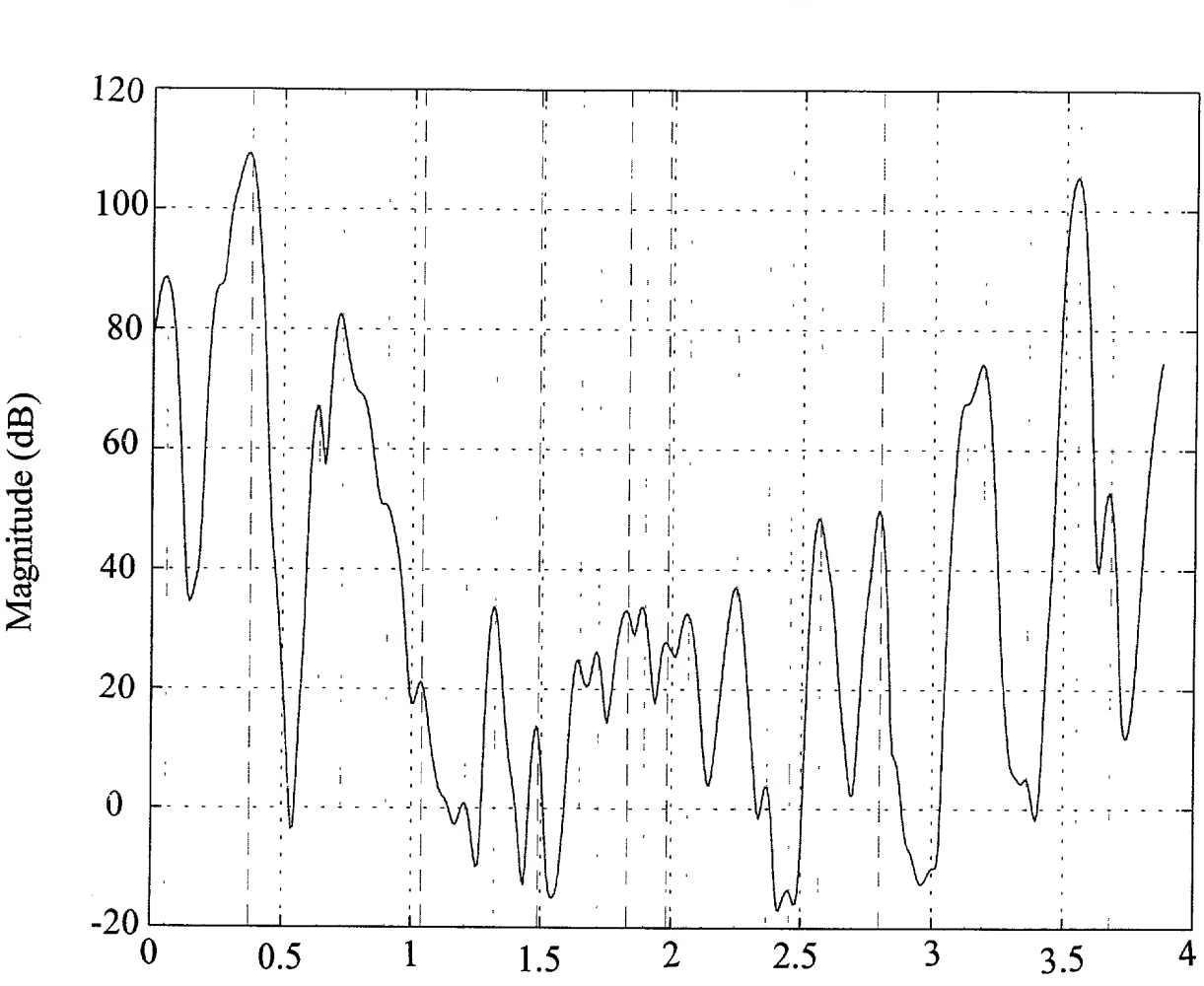
Landmarks in L4 Norm
Magnitude (dB)
120
100
80
60
40
20
0
-20
0
0.5
1
1.5
2
2.5
3
3.5
4
Time (sec) [64-sample frames]

FIG. 5

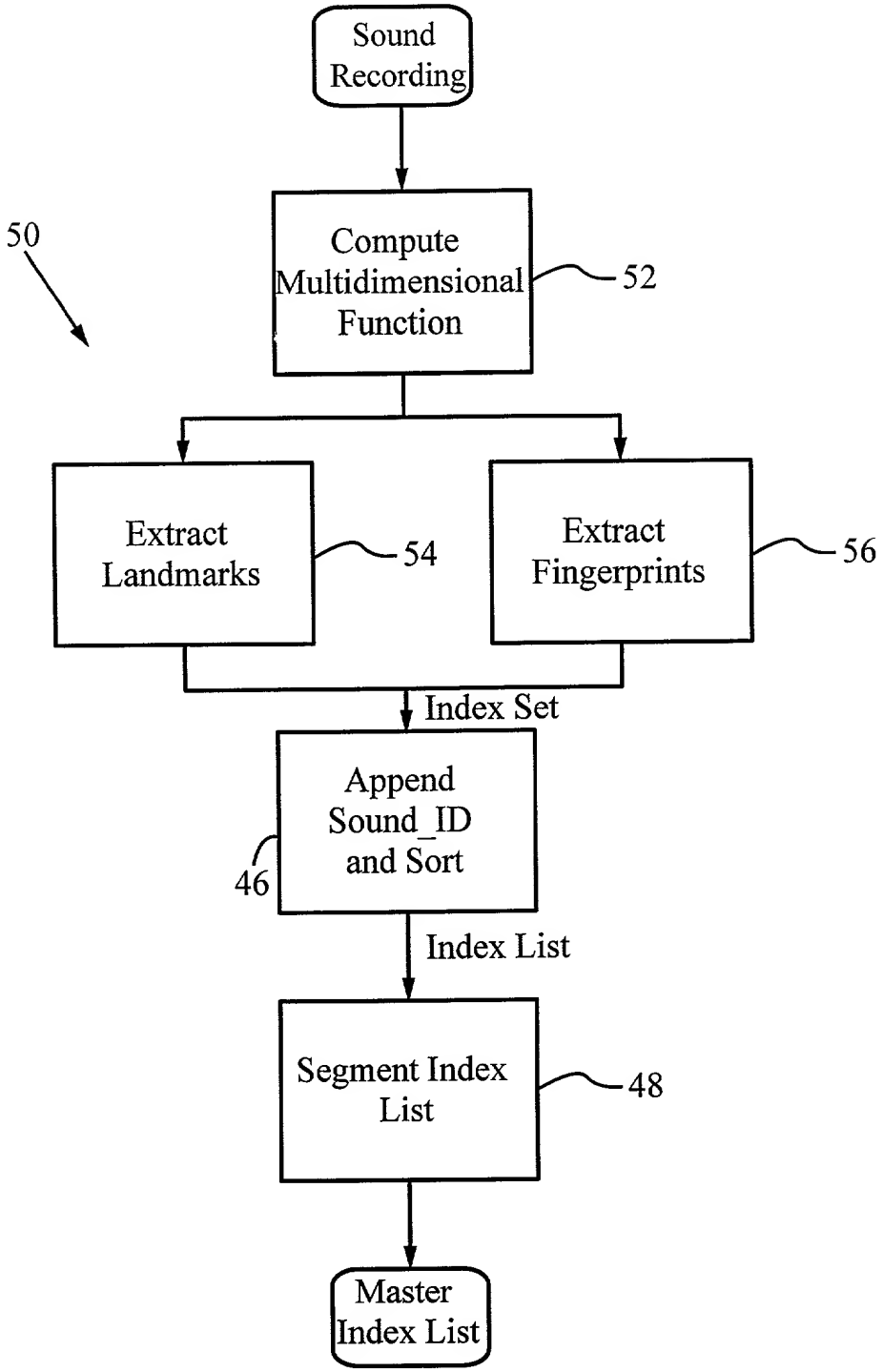
Sound Recording
50
Compute Multidimensional Function
52
Extract Landmarks
54
Extract Fingerprints
56
Index Set
Append Sound_ID and Sort
46
Index List
Segment Index List
48
Master Index List

FIG. 6

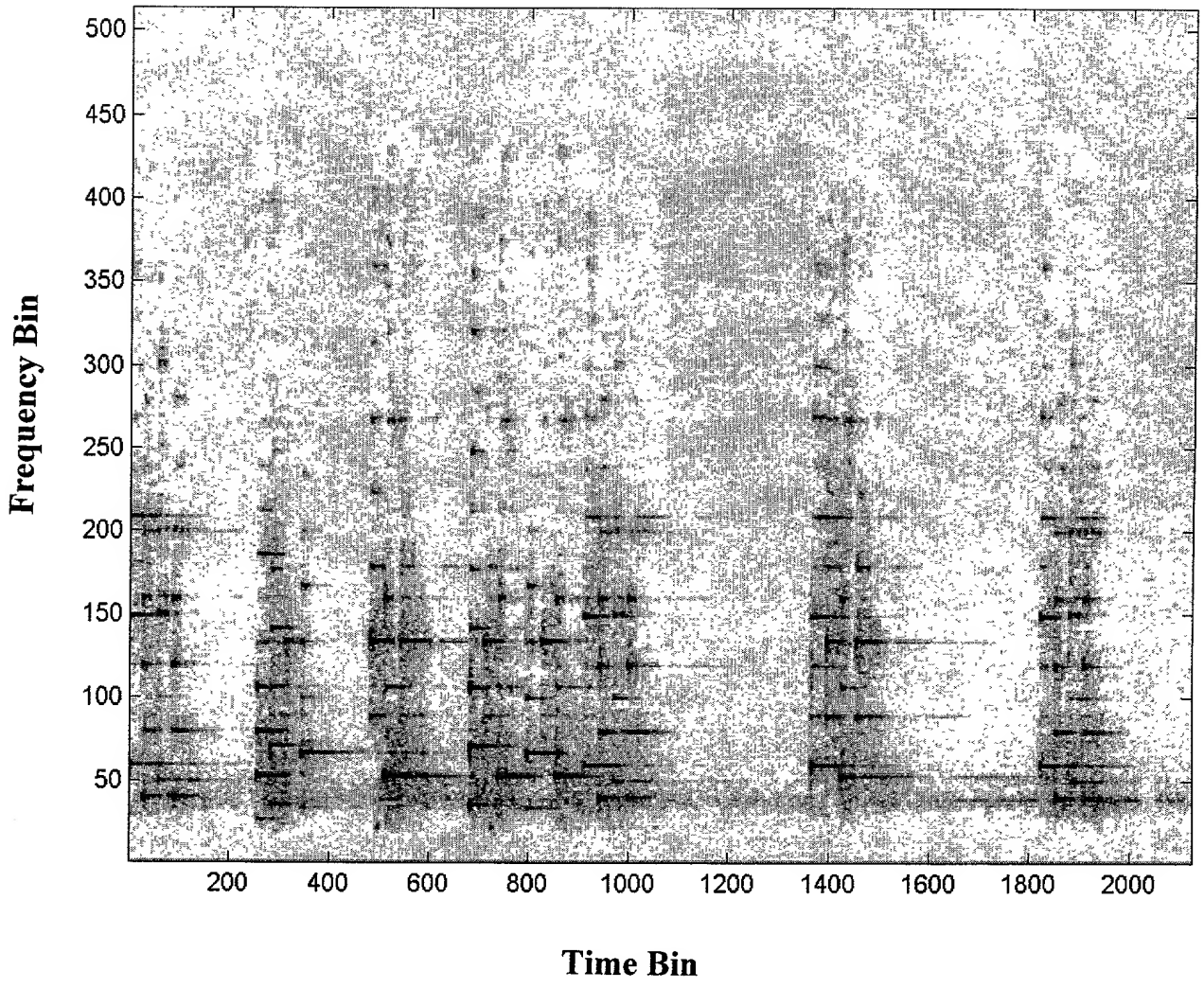
Frequency Bin
500
450
400
350
300
250
200
150
100
50
200
400
600
800
1000
1200
1400
1600
1800
2000
Time Bin

FIG. 7A

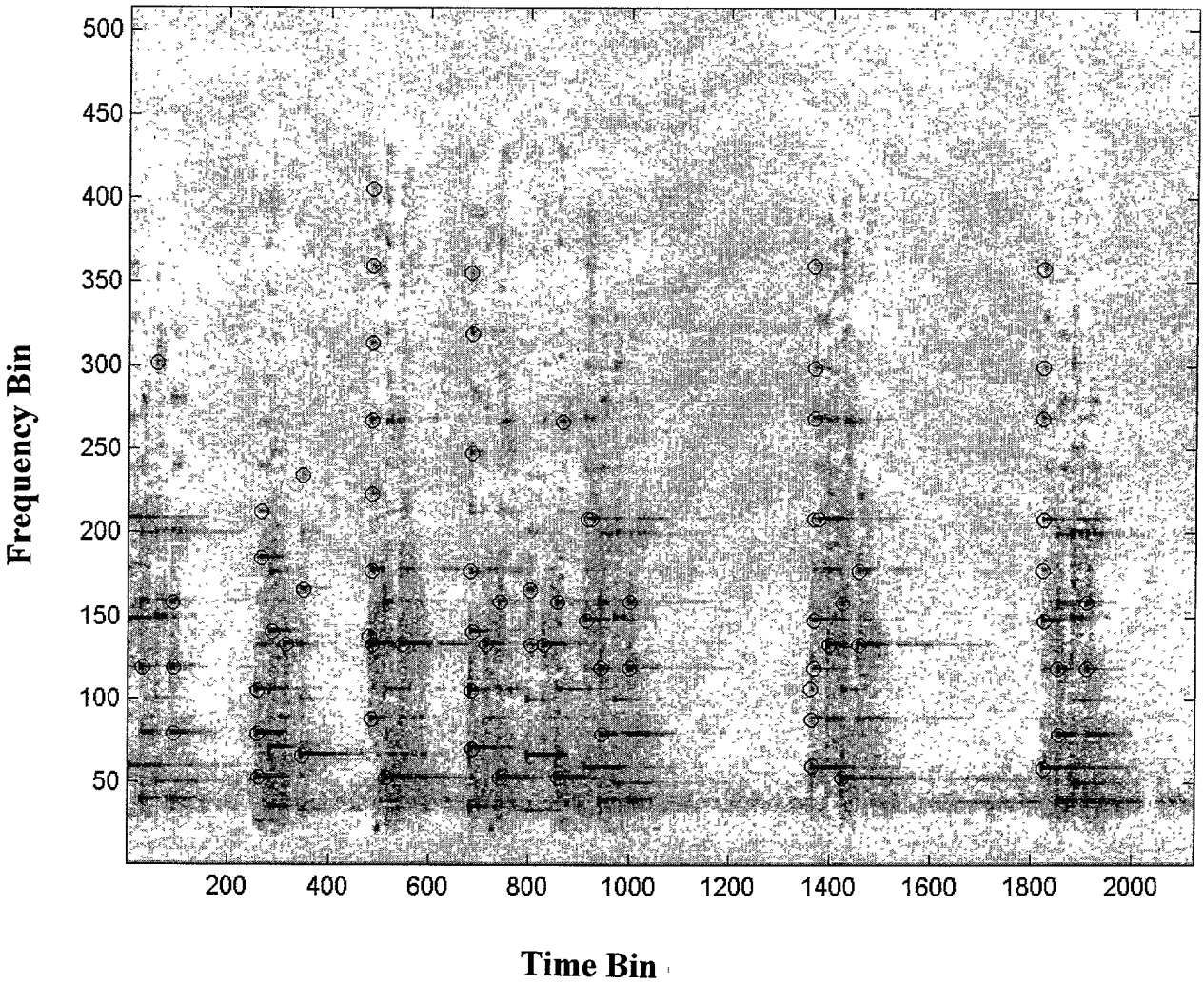
Frequency Bin
500
450
400
350
300
250
200
150
100
50
200
400
600
800
1000
1200
1400
1600
1800
2000
Time Bin

FIG. 7B

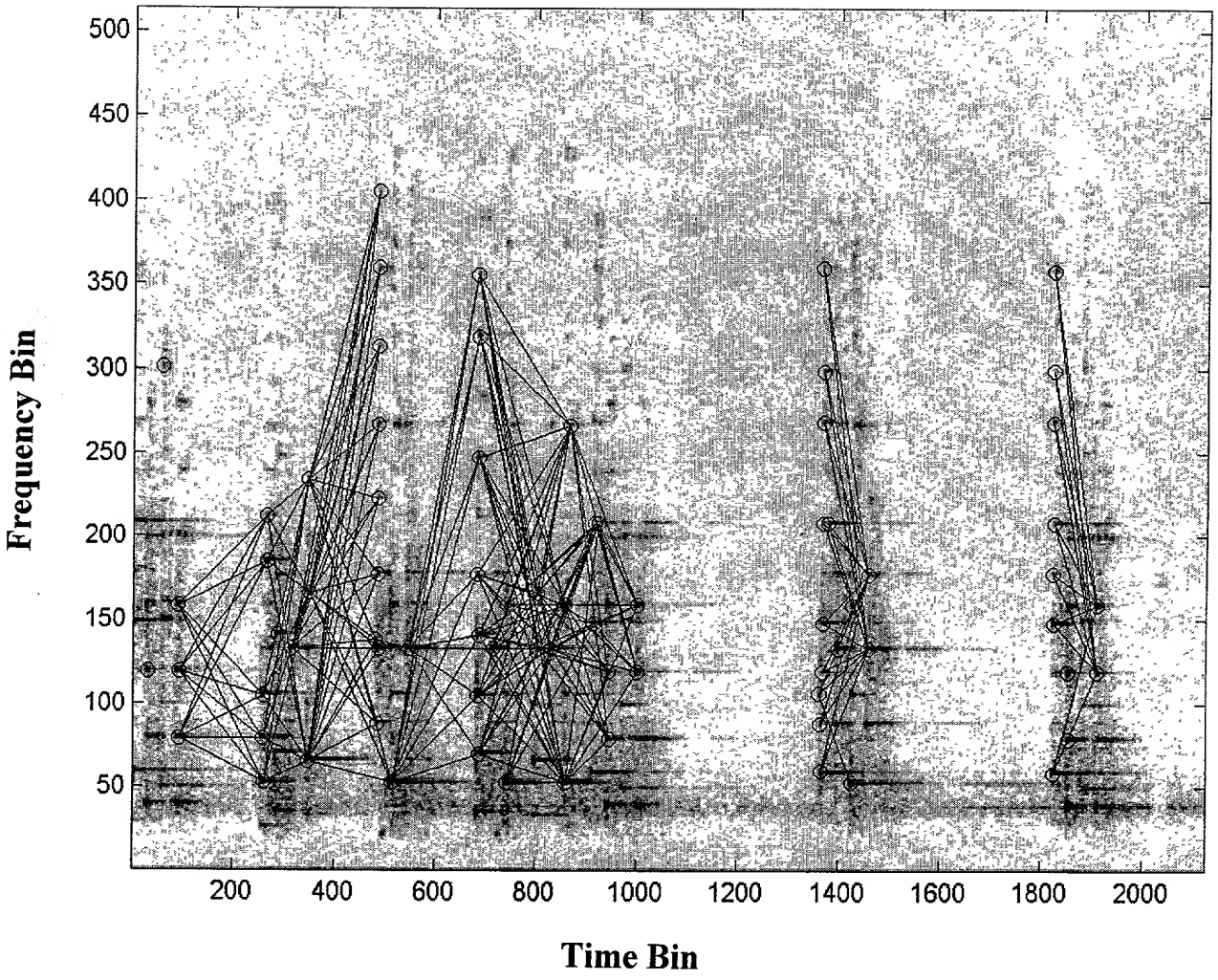
Frequency Bin
500
450
400
350
300
250
200
150
100
50
200
400
600
800
1000
1200
1400
1600
1800
2000
Time Bin

FIG. 7C

Index Sets

$$\begin{bmatrix} \text{Sound_ID}_1 \\ (\text{fingerprint}_1, \text{landmark}_1) \\ (\text{fingerprint}_2, \text{landmark}_2) \\ \vdots \\ (\text{fingerprint}_m, \text{landmark}_m) \end{bmatrix} \cdots \begin{bmatrix} \text{Sound_ID}_n \\ (\text{fingerprint}_p, \text{landmark}_p) \\ (\text{fingerprint}_{p+1}, \text{landmark}_{p+1}) \\ \vdots \\ (\text{fingerprint}_t, \text{landmark}_t) \end{bmatrix}$$

FIG. 8A

Index List

$$\begin{bmatrix} (\text{fingerprint}_1, \text{landmark}_1, \text{sound_ID}_1) \\ (\text{fingerprint}_2, \text{landmark}_2, \text{sound_ID}_1) \\ \vdots \\ (\text{fingerprint}_m, \text{landmark}_m, \text{sound_ID}_1) \\ \vdots \\ (\text{fingerprint}_p, \text{landmark}_p, \text{sound_ID}_n) \\ (\text{fingerprint}_{p+1}, \text{landmark}_{p+1}, \text{sound_ID}_n) \\ \vdots \\ (\text{fingerprint}_t, \text{landmark}_t, \text{sound_ID}_n) \end{bmatrix}$$

FIG. 8B

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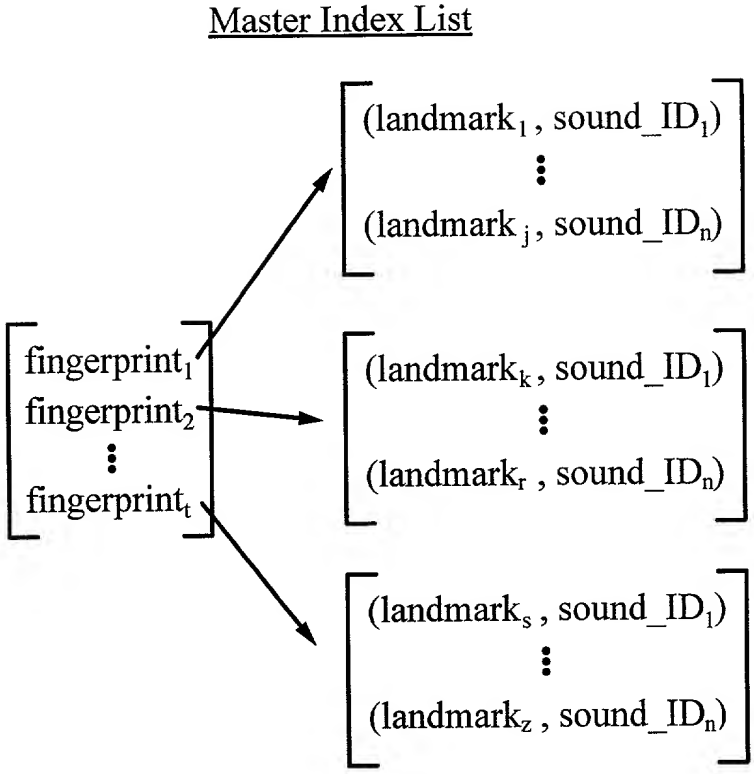
Master Index List
(landmark$_1$, sound_ID$_1$)
(landmark$_j$, sound_ID$_n$)
fingerprint$_1$
fingerprint$_2$
fingerprint$_t$
(landmark$_k$, sound_ID$_1$)
(landmark$_r$, sound_ID$_n$)
(landmark$_s$, sound_ID$_1$)
(landmark$_z$, sound_ID$_n$)

FIG. 8C

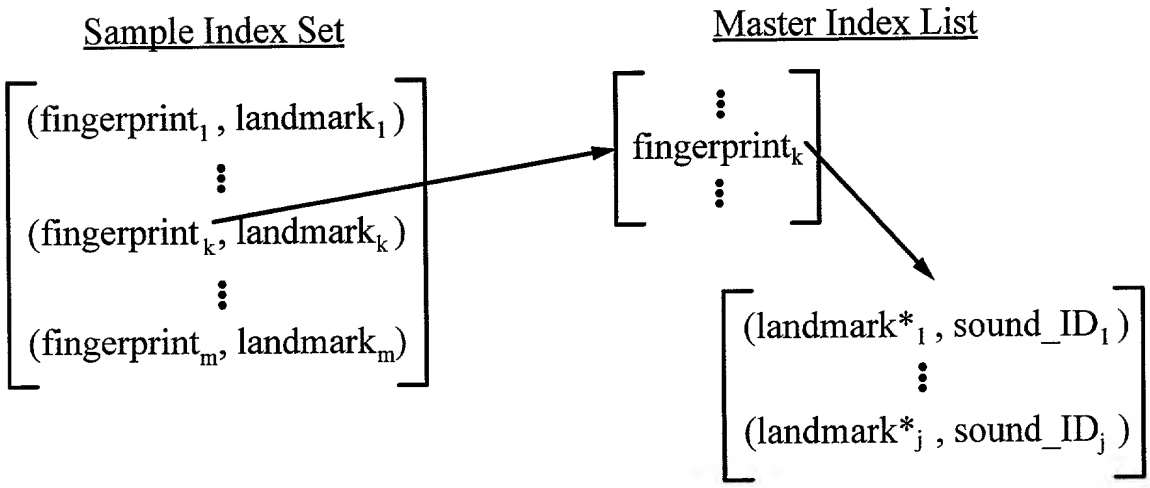
Sample Index Set
(fingerprint$_1$, landmark$_1$)
(fingerprint$_k$, landmark$_k$)
(fingerprint$_m$, landmark$_m$)
Master Index List
fingerprint$_k$
(landmark*$_1$, sound_ID$_1$)
(landmark*$_j$, sound_ID$_j$)

FIG. 9A

Candidate List

$$\begin{bmatrix} (\text{landmark}_1 , \text{landmark*}_1 , \text{sound_ID}_1) \\ \vdots \\ (\text{landmark}_k , \text{landmark*}_j , \text{sound_ID}_j) \\ \vdots \\ (\text{landmark}_m, \text{landmark*}_r , \text{sound_ID}_n) \end{bmatrix}$$

FIG. 9B

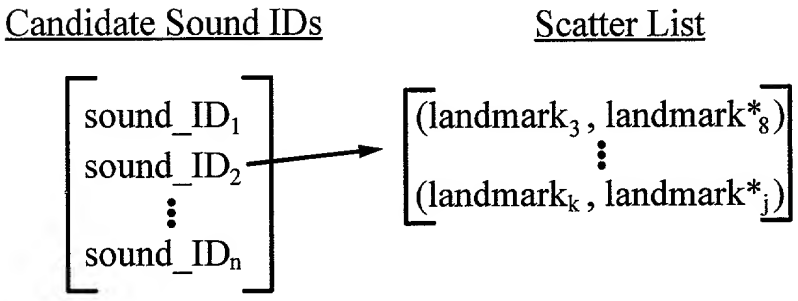

FIG. 9C

US 6,990,453 B2

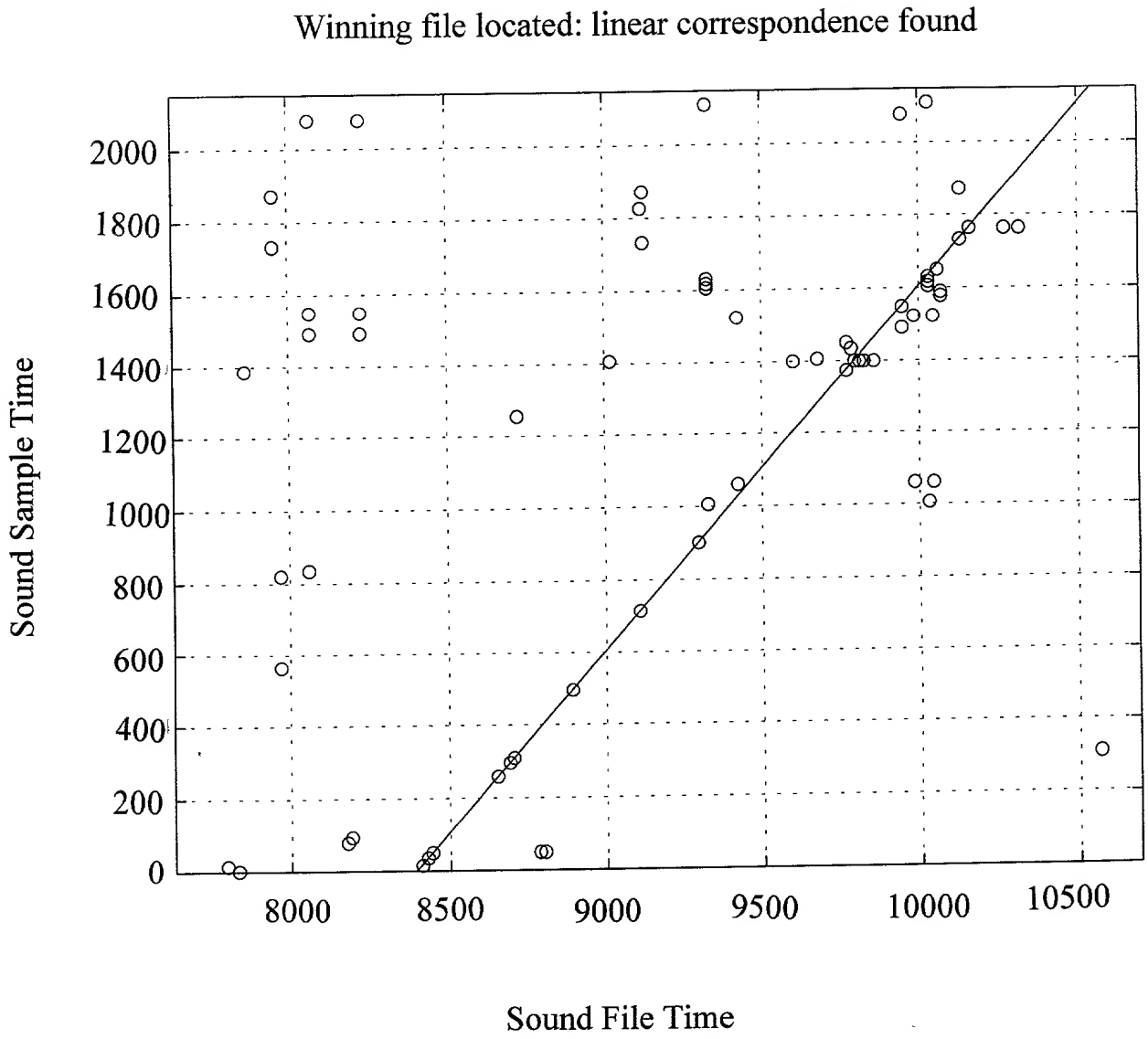
Winning file located: linear correspondence found
Sound Sample Time
Sound File Time
0
200
400
600
800
1000
1200
1400
1600
1800
2000
8000
8500
9000
9500
10000
10500

FIG. 10A

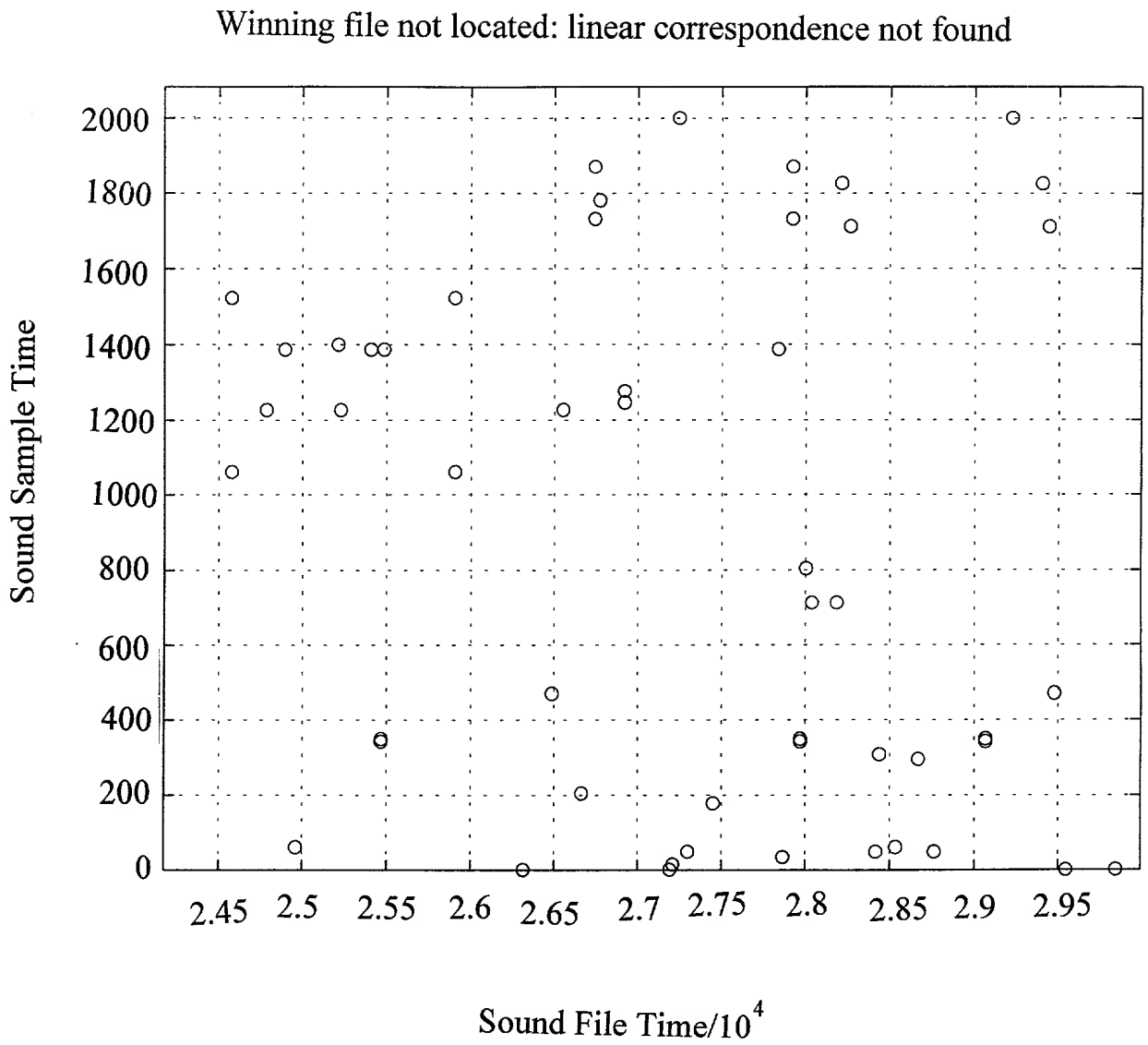
Winning file not located: linear correspondence not found
Sound Sample Time
2000
1800
1600
1400
1200
1000
800
600
400
200
0
2.45
2.5
2.55
2.6
2.65
2.7
2.75
2.8
2.85
2.9
2.95
Sound File Time/10^4

FIG. 10B